

REMARKS

This amendment is responsive to the non-final Office Action issued November 13, 2009. Reconsideration and allowance of claims 2-4, 6-10, and 14-19 are requested.

The Office Action

Claims 1 and 17 stand rejected under 35 U.S.C. § 112, second paragraph.

Claims 1-4, 7, 8, and 14-16 stand rejected under 35 U.S.C. § 103 over Zarkh (US 2008/0247621).

Claim 6 stands rejected under 35 U.S.C. § 103 over Zarkh as modified by Mo (US 6,413,217).

Claims 9 and 10 stand rejected under 35 U.S.C. § 103 over Zarkh as modified by Webler (US 2007/0055142).

Claim 17 does not stand rejected on art and is understood to contain allowable subject matter when the 35 U.S.C. § 112 issue is resolved.

The Zarkh Reference

Zarkh describes an elaborate and computationally intensive method for tracking a catheter moving through the blood vessels of a patient. As described starting at paragraph 35, Zarkh injects contrast agent into a vessel which turns the vessel black or dark and easy to see in the image. Zarkh then uses the surfaces of this vessel to define a centerline and then using the equations and matrices defined on the following pages, tracks the tip of the catheter through the vessel.

The Present Application

The present application uses a much simpler technique which does not require the intensive processing of Zarkh. The present technique is also particularly suited to noisy images in which some of the structures discussed by Zarkh are hard to define.

In the present application, an imageable tip on the catheter is moved through a vessel. As it moves, a series of noisy, e.g., fluoroscopy mode, images are

generated. Because the tip has good contrast, it is easily identified in the images. Once the tip is identified, its centerline is easily identified. By comparing the centerline of the tip in the most recently acquired image with the centerline of the tip in one of the previously acquired images which is designated to be the reference image, a motion vector describing the orientation of the most recently acquired image to the reference image can be easily be determined.

The most recently acquired image is then registered to the reference image. For example, the current image can be appropriately rotated and/or shifted. This brings the centerline of the tip and the vessel adjacent the tip in the most recently acquired image into alignment with the reference image.

Particularly adjacent the heart, the vessel moves significantly with cardiac and respiratory motion. Due to this motion, the anatomy around the vessel changes from image to image. It should be kept in mind that fluoroscopy mode images are projection images which include not just the anatomy right around the vessel, but a projection of all anatomy between the x-ray source and detector. During this motion, the vessel in question and the anatomy between the x-ray source and detector tend to move relative to each other.

When the current image is registered with the reference image, the tip of the catheter and a vessel wall adjacent the tip are brought into alignment, but anatomy outside of the vessel to varying degrees is not.

To enhance the vessel in order to get a good sharp easy to read image of the vessel, the present application simply sums or averages the most recently acquired image with a plurality of preceding images, all registered to the reference image. Because the vessel is in the same location and orientation in every image, the images of the vessel add. Because the background is not aligned, it blurs. Thus, by this simple image combining technique, an enhanced image of the blood vessel around the guide-wire tip is generated.

Moreover, the centerline of the tip is also identified. Rather than imaging the guide-wire itself, which may not be readily imaged, the centerline of the guide-wire tip is displayed in each of the combined images. This provides a trajectory which defines the path of the guide-wire.

This discussion is not meant to define or limit the claims, but to assist the Examiner in understanding the subject matter of the patent application.

**The Claims Distinguish Patentably
Over the References of Record**

Claim 15 has been amended to call for integrating a plurality of the noisy images of the sequence that are registered to a reference image. This enhances the blood vessel and blurs the background.

Neither Zarkh nor the other references of record disclose or fairly suggest enhancing a blood vessel by summing a plurality of noisy images registered to a common reference image. Accordingly, it is submitted that claim 15 distinguishes patentably over the references of record.

Claim 16 has been amended to emphasize that the guide-wire and vessel walls are enhanced by integrating the most recently acquired image and a plurality of preceding noisy images, all of which have been registered to a common reference image. Moreover, such combining or integrating enhances a ridge or line corresponding to the centerline of the tip in the most current and preceding images.

Because Zarkh and the other references of record fail to disclose or teach that a guide-wire and vessel walls can be enhanced while blurring the background by aligning the most recently acquired and preceding noisy images of a sequence to a common reference image and integrating pixel intensities, it is submitted that claim 16 distinguishes patentably over the references of record.

Claim 17 has been amended to delete the indefinite subject matter. Because claim 17 does not stand rejected on art, it is submitted that claim 17 distinguishes patentably and unobviously over the references of record.

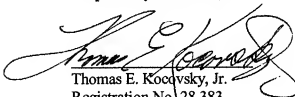
New claim 19 is based on now cancelled claim 1. However, claim 19 eliminates the means-plus-function language and presents the previously-discussed concepts more clearly. Accordingly, it is submitted that claim 19 and claims 2-4, 6-10, and 14 dependent therefrom distinguish patentably and unobviously over the references of record.

CONCLUSION

For the reasons set forth above, it is submitted that claims 2-4, 6-10, and 14-19 distinguish patentably over the references of record and meet all statutory requirements. An early allowance of all claims is requested.

In the event the Examiner considers personal contact advantageous to the disposition of this case, the Examiner is requested to telephone Thomas Kocovsky at 216.363.9000.

Respectfully submitted,



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